



propel

The 2021 Modern Manufacturing Report

What's coming next in manufacturing.

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Introduction

The personal computer revolution.

The rapid rise of the internet.

September 11, 2001.

The December 26, 2004, Indian Ocean tsunami.

COVID-19.

What do these events have in common?

They're all black swan events. Nassim Taleb – who [wrote the book](#) on this – defines black swans as unpredictable events that are beyond what is normally expected of a situation and usually has severe consequences. Seemingly random, at least to those who do not expect them, these events change the trajectory of history forever.

The most resilient businesses have weathered many black swan events – and it isn't by chance. While we can't completely prepare for or predict natural disasters, rapid rises in technological advancement, and other outwardly unexpected occurrences, the savviest companies analyze historical data to predict future trends and needs.

They prepare for the future by looking at the past. And it doesn't necessarily have to be their own past, but of the larger industry-wide trends that enabled some companies to succeed and led others to failure in the last few black swan events.

Manufacturers, of all shapes and sizes, were forced to change their practices due to the most recent black swan event: COVID-19.

From having to make the majority switch to remote work to finding new suppliers and manufacturing partners, the impacts of coronavirus will be felt for decades to come. As of writing this, we're in the midst of a second wave around the world.

We've seen manufacturers make incredible pivots and adaptations to their value chains to ensure customer satisfaction. By putting the

customer first, even in the most unknown of circumstances, companies were able to adapt, innovate, and drive revenue growth. While it has been tremendously sad to see other companies file bankruptcy or completely go under, we must remember the lessons we can learn from them.

If you ask scientists, many of them predicted we would experience a pandemic at some point. It's just that we weren't listening.

Many of the brightest minds predicted previous black swan events as well. Marshall McLuhan predicted the rise of the internet years before it happened. Steve Jobs made big bets on the smartphone before anyone saw its real potential.

How can some predict these events and others call them random and unpredictable?

They analyze the past to predict the future. It's as simple, and as complicated, as that.

There are bigger macro trends that will continue impacting manufacturers long after coronavirus. They may seem like black swan events – but if we begin to analyze trends, events, and processes today, we can begin to predict tomorrow. From China's continued dominance to shifting employee trends, these changes will shape the next ten years on top of the implications of the coronavirus.

In this piece, we aim to predict the future by interpreting seemingly random and disconnected events and patterns across manufacturing. By analyzing these current events, we can better prepare for the future ahead – which, for manufacturers, is an increasingly fast-paced and ever-changing world.

To the future,



Ray Hein,
CEO, Propel

Globalization

“In the midst of chaos, there is also opportunity.” – Sun Tzu, The Art of War

Globalization describes the growing interdependence of the world’s economies, cultures, and populations. Brought about by cross-border trade in goods and services, technology, and flows of investment, people, and information, globalization, once a threat, is now the largest opportunity for success.

Many organizations realized that having a limited value chain that was highly dependent on certain regions or suppliers was detrimental. Diversification across the value chain enables them to never be reliant on a single source, which can jeopardize their very existence if interrupted.

From diversifying workforces around the world to creating global pathways for goods to flow from, globalization is here to stay – even as many nations, including the United States, start to look inward at nationalism.

While these countries look inward, the world reflects continued globalization.

The Belt and Road Initiative




To understand down-the-line predictions on global value chains, we must first look at the most populous regions for manufacturing.

First, is the shift in global powers around the world. A primary example of this shift can be seen in China.

The Chinese economy experienced immense growth over the last few decades to become the world’s second largest economy. In 2013, China surpassed the United States as the world’s biggest trading nation.¹

Top 10 Countries by Exports (2019)

Rank	Country	Exports (Millions of \$)	% of GDP
1	 China	2,643,377	18.4%
2	 United States	2,498,032	11.7%
3	 Germany	1,810,933	47.0%
4	 Japan	904,883	18.5%
5	 UK	891,875	31.5%
6	 France	882,761	31.8%
7	 Netherlands	750,172	82.5%
8	 South Korea	669,594	39.8%
9	 Singapore	645,6121	73.5%
10	 Italy	632,6193	1.6%

This growth is fueled by China's embrace of capitalism – albeit within a single-party communist government. This is a relatively new path that started in the 1990s with Jiang Zemin, the President of the People's Republic of China from 1993 to 2002, embracing the socialist market economy. Xi Jinping, China's current President of the Republic, is accelerating these changes. Given China's size, we can expect the country to surpass the USA in terms of market size by 2028. ²

China's middle class has been one of the fastest growing in the world, moving from 29 million in 1999 – roughly 2% of the population – to approximately 531 million in 2013 or 39% of the population. ¹ A recent McKinsey analysis illustrates the Chinese middle class could reach 550 million by 2022 – more than one-and-a-half times the entire U.S. population today.

But, the coronavirus has thrown a wrench into that growth. China's economy contracted 6.8% in the first quarter of 2020. Over 460,000 Chinese firms closed. The creation of new businesses fell 29% year-over-year between January and March 2020. This is the first recorded contraction since before Mao-era collectivization was abolished in the late 1970s. ³



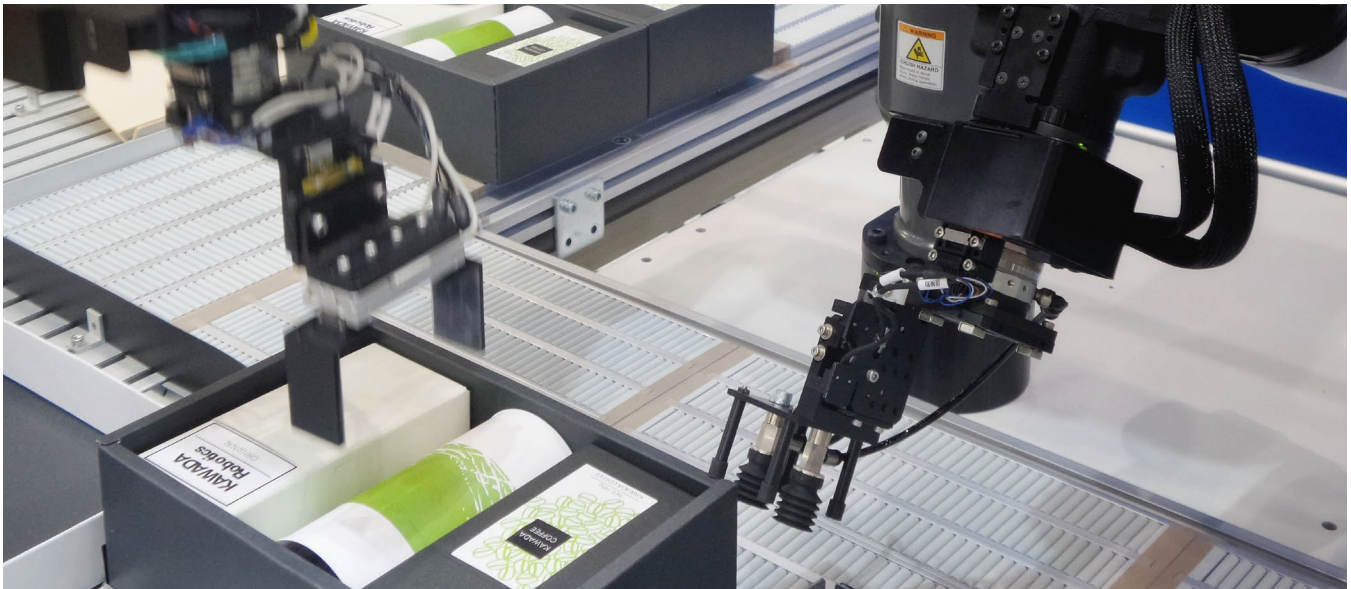
However, the Chinese economy is still going to overtake the U.S. faster than anticipated – thanks in part to their COVID-19 response. Because China was able to bounce back faster from the pandemic than other nations, they have an unprecedented advantage.

Chinese President Xi Jinping said it was “entirely possible” for the Chinese economy to double in size by 2035 under his government's new Five-Year Plan. The goal is to create “modern socialism” in 15 years.

As the globe's biggest trading nation and number two economy, amounting to 28% of global growth in the five years from 2013 to 2018, what happens in China will impact everyone from a macroeconomic perspective.

China is leveraging this economic growth to expand its Belt and Road initiative, which is an aggressive plan to build a network of highways, railways and pipelines linking Asia via the Middle East to Europe and south through Africa. ⁴ The Belt and Road spans nearly 65 countries, covers 70% of the planet's population, three-quarters of its energy resources, a quarter of goods and services and 28% of global GDP—nearly \$21 trillion. Many call this China's over 900 billion dollar plan to re-create the Silk Road and position China as the dominant manufacturing (and beyond) force across the world.

Others refer to the Belt and Road initiative as this century's Marshall Plan, a U.S. program that provided aid to Western Europe following the destruction of World War II. The Marshall plan was much smaller than China's investment at only \$15 billion (about \$150 billion in today's money), but this spend, like China's Belt and Road, influenced commerce between nations and spread goodwill for America. China will have huge influence over every country that accepts the funds from this initiative. This comes at a time when America is retracting from globalization and will be



hard fought to catch up to China's impact on these regions.

This massive potential shift in economic and political power will influence value chains for decades. China's continued economic rise coupled with greater ties to international partners will ensure their seat at the global supply chain table for the foreseeable future.

But this rapid expansion comes with a downside risk to China's long term success. China's total debt (public and private) is estimated to be over 248.8% of GDP. In 2020, due to Coronavirus, the Chinese government unveiled a bigger fiscal deficit target for the year and off-budget measures to bolster economic growth and foster employment. According to analysts, the size of the total fiscal stimulus will amount to around 7% of GDP - up from their typical 2%. Granted, many western countries are also grappling with high debt loads. But most of those are government debts. China's debt bubble is driven by private entities, making it more difficult to accurately forecast how they will impact the overall economy.⁵

Regardless of its debt, China will continue to grow and become an even greater economic powerhouse. Looking at China through a macroeconomic lens provides a

clearer picture of global economic trends and impacts. The country's leadership will not change for the foreseeable future, which will continue their domination of the East.

How will the Belt and Road Initiative impact your business?

PROPEL PREDICTION

The new U.S. administration will shift back to a globalist perspective rather than the nationalism we've seen over the past four years but tensions - and the trade war - with China will continue. This won't be enough to displace China's role as the epicenter of growing global trade. The country's Belt and Road Initiative, growing economy, and advancements in technology - especially 5G - means the Industry 4.0 revolution is already in full speed in China while U.S. and other manufacturing nations are lagging behind.

Trade Wars and Tariffs



China's growing power is shifting global economic trade deals.

The United States is currently in a global trade war – with China as a primary target.

President Donald Trump's "America's First" policy resulted in tariffs across countries and goods including aluminum, steel, solar panels, wine, and more. China is by far the most impacted by these tariffs.

The current tariffs stress a sizable tax on U.S. companies and consumers, that adds additional costs and red tape for small businesses, farmers, manufacturers and households. Tariffs aren't the only cost themselves – it's also about the deadweight loss of consumers buying more expensive or less efficient products. Tariffs are passed onto consumers and result in less buying power which will have a negative impact on GDP. Farmers impacted by China's retaliation are receiving direct payment from the United States government that, ultimately, are funded by taxpayers. There are no real winners in this trade war.

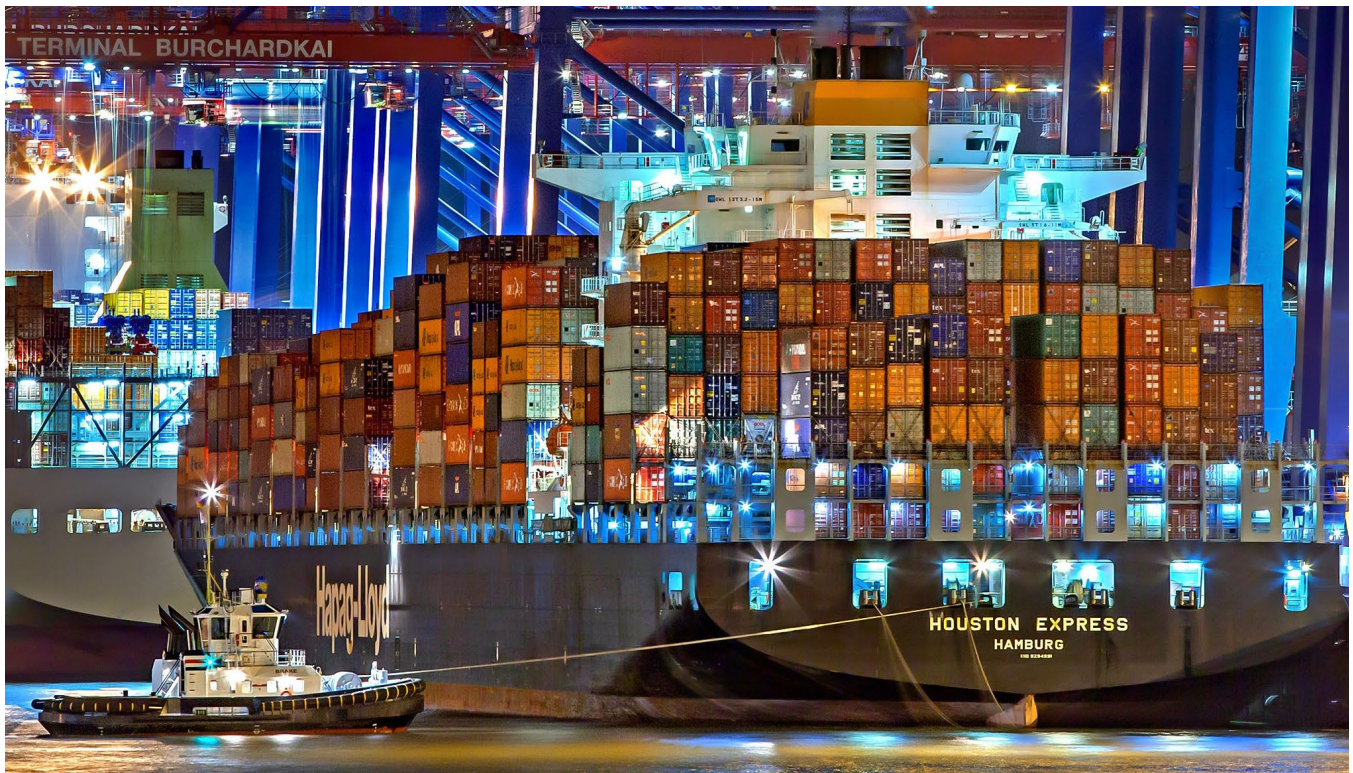
Regardless of Joe Biden's win, leading economists believe that this trade war will continue for years to come. This will continue to create an undue burden on consumers and continue to put small business owners out of business.

But, China isn't the only country America is in a trade disagreement with.

The North American Free Trade Agreement, also known as NAFTA, is a treaty formerly entered into by the United States, Canada, and Mexico that went into effect on January 1, 1994. NAFTA resulted in the reduction and elimination of trade barriers between the three countries. It immediately brought the elimination of tariffs on more than one-half of Mexico's exports to the United States and more than one-third of United States exports to Mexico. Ten years later, all U.S.–Mexico tariffs were eliminated except for some U.S. agricultural exports to Mexico. A majority of U.S.–Canada trade was already duty-free by this point.

In 2008, Canadian exports to the United States and Mexico were at \$381.3 billion, with imports at \$245.1 billion. Income in the Mexican assembly plants sector increased 15.5% since the implementation of NAFTA in 1994. A 2014 study on the impacts of NAFTA on United States trade jobs and investments found that between 1993 and 2013, the United States trade deficit with Mexico and Canada increased from \$17.0 to \$177.2 billion, displacing 851,700 United States jobs.⁶

Many have disputed the employment, environment, and economic growth impacts of the trade deal. A majority of economic analyses highlight how NAFTA was beneficial to North American economies and people but also caused harm to workers in industries where trade competition was higher. Most economists also felt that withdrawing from NAFTA or renegotiating to reestablish trade barriers would have an impact on the United States economy.



In 2018, the USMCA, also known as the United States–Mexico–Canada Agreement, was enacted; it was ratified in early 2020 and took effect on July 1, 2020, replacing NAFTA. Negotiations focused largely on automobile exports, steel and aluminum tariffs, and the dairy, egg, and poultry markets. In comparison to NAFTA, USMCA increases environmental and working regulations while also incentivizing more domestic production of cars and trucks. The agreement also provides updated intellectual property protections and prevents any party from passing laws that restrict the cross-border flow of data.⁷

While President Trump made dramatic notions, USMCA equates more to NAFTA 1.1 than it is a true overhaul or NAFTA 2.0. Increasing the regional value component minimum from 62.5% to 75% will have some impact on U.S. manufacturing, such as more onshoring, but it will be small.

These trade wars and tariffs will likely result in regional trading agreements expanding and contracting, creating a lasting impact on global value chains. If regions continue

to disagree about trade, this could result in countries moving to more locally sourced and manufactured goods.

Is your business already impacted by tariffs? Are you braced for impact if not?

PROPEL PREDICTION

Outside of China, we will see a reduction in tariffs overall from the new U.S. administration. However, the impact of the last four years will have lingering effects over the next decade. Long term U.S. trading partners have learned their preferred status can be easily revoked with the next election, and they will minimize their risk by diversifying trade beyond the U.S.

Nearshoring and Onshoring

Nearshoring is defined as the practice of transferring a business operation to a nearby country – especially over a more distant one. Onshoring is manufacturing where your end customer is or in the country where the business is located.

Nearshoring is here to stay.

Imports from Mexico have risen steadily since 2009, a \$13 billion increase in imports from Mexico to the U.S. happened in 2019 alone. With the explosion and expansion of eCommerce, we will only see more nearshoring and reshoring as companies' need to adjust to consumer demands quickly continues to rise. ¹¹

63% of those surveyed by AlixPartners, a business advisory firm, named Mexico the most attractive country for moving manufacturing operations closer to the United States. Aerospace manufacturing is one industry flocking to Mexico for its lower cost structure and large, skilled workforce. ¹ In terms of exports of high-tech manufacturing, Mexico is the second

largest supplier of electronic products to the United States. Exports from Mexico to the U.S. have 40% U.S. content whereas exports from China have only 5% U.S. content. ⁸

Beyond consumers desire to “need it now”, customers are also eager for customized products. Nearshoring allows faster fulfillment and a better customer experience. This experience was put to the test this past year when the pandemic impacted product availability worldwide.

Coronavirus' disruption to global supply chains influenced many manufacturers to make the shift to nearshoring. In general, those who were already nearshoring saw less disruptions than those who offshored far away from their customers in the beginning of the pandemic. This was caused by two significant trends. First, while China's supply chain was first disrupted by the pandemic, many other nations, closer to the U.S., didn't feel such impacts until later. Once the pandemic hit the U.S. and western Europe, transportation networks were interrupted. The greater the distance traveled, the greater the chance of transportation interruption.

Benefits of nearshoring

- Enabling more frequent visits to the manufacturing facilities
- Improved control over intellectual property
- Similar time zones – which improves communication.
- Faster time to customer
- Improved control of supply chain
- Greater speed to market
- Lower customs, duties, and other trade relation impacts

Disadvantages to nearshoring

- Fewer manufacturing facilities
- Typically higher production cost
- Higher competition for skilled labor

These past few years, we've also seen a national calling to bring back manufacturing jobs. While some companies have shifted their focus to onshoring at least parts of their businesses, the U.S. has suffered a net loss of more than 91,000 manufacturing plants and nearly 5 million manufacturing jobs since 1997. However, the U.S. did gain roughly 500,000 U.S. manufacturing jobs from 2016 to 2019. But these gains are on par with gains across the entire economic recovery period from 2010 to 2019, during which, on average, 166,000 manufacturing jobs were gained each year.

Recent years' manufacturing employment gains were cut by coronavirus —with a staggering 740,000 manufacturing jobs lost in 2020.⁹

Transportation costs are also driving nearshoring and onshoring. On average, it costs about \$4,300 to ship a 40-foot container to the U.S. from China and takes five weeks to arrive. The same shipment from Mexico would cost \$1,800 and take just a few days. Shipping costs from Mexico can drop even further if the firm can take advantage of de minimis shipments from Mexico in the U.S. Code of Federal Regulations, which sets a \$800 minimum value on shipments allowed into the United States duty-free.¹⁰

That means, from a pure logistics perspective, the economics for nearshoring or reshoring make sense.

Manufacturers are forced to balance between these two pulls – chase cheap labor or deliver nearly on-demand to their customers.

For decades, companies have been chasing more efficient and less expensive labor. In the '70s and '80s, both the fashion industry and high-tech companies looked for low cost labor locations. Vietnam, Singapore, Malaysia, and then to China as new locations to establish supply chains.



As the demographics change and wages increase, there's been a constant demand to find and establish new sources of supply and value chains. This happened in the early 1990s in Singapore, causing companies to move to China. Now that China's middle class is booming and wages are increasing, the cost to produce goods in China is rising.

When it will cost American companies the same amount to produce something in China as it does Mexico, it makes more sense to make the product in Mexico because of lower shipping costs and transit times. This assumes everything else between China and Mexico remains equal, which of course is never the case.

Beyond costs, we must look at quality.

Inputs from an immature or new supply chain often lead to lower product quality, potentially costly product returns, legal liability, and brand loyalty issues. Lower product quality means that consumers can lose trust in a brand, especially brands who focus on product.

If there are high rates of product returns or even potential callbacks, this not only costs the company money but it costs consumer trust. If a product is called back due to potentially dangerous incidents, legal liability skyrockets – which can cost an organization millions.

Globalization trends like the Belt and Road Initiative and continued tariffs may have manufacturers rethinking and overhauling their value chains – from primary activities like outbound logistics to secondary activities like nearshoring or onshoring customer support.

Could we see a huge boom in manufacturing jobs coming back to the U.S.? While unexpected, this could happen if employment prices continue to rise in major offshore countries and shipping prices increase. Additionally time to market and product quality matter even more today, ensuring the push and pull between nearshoring and offshoring will continue.

PROPEL PREDICTION

We will continue to see manufacturers explore nearshoring throughout their value chains – not just their supply chains. As manufacturing factory floors become digitized, variable labor costs will be replaced with fixed costs, and manufacturing jobs become more skilled. Skilled labor will continue to have a place in even the most expensive markets, while lower-level jobs will move to low cost centers around the world.



Industry 4.0 Technology

Technology and manufacturing have always developed side by side. The latest technology is producing what we know as smart manufacturing, or Industry 4.0.

A 2019 survey showed 26 percent of all middle market manufacturers developed an Industry 4.0 strategy, with another 28 percent in the process of developing one, while only 5 percent have reached the implementation stage.¹²

This means there is a huge opportunity to take advantage of new technology. Smart manufacturing is the latest jump in revolutionizing the way we live and work. Just like computers and mobile phones revolutionized communication in Industry 3.0, Industry 4.0 technology is revolutionizing manufacturing.

Recently, PWC conducted a survey where 91% of surveyed respondents stated they are investing in digital factories but only 6% consider their factories to be fully digitized.¹³ Now is a tremendous time to be a first mover – or at least not get left behind in the digital dust.

There are potential downfalls to implementing new technology. A 2017 survey found that 14 percent of all IT projects completely fail. Of the projects that didn't fail outright, 31 percent didn't meet their goals, 43 percent exceeded their initial budgets, and 49 percent were late.¹⁴ From inaccurate requirements and estimates to unexpected risks and dependencies to lack of resources and executive sponsorships, there's a lot of room for error when implementing new technology – which is why having a comprehensive plan is so important.

Before you start implementing smart manufacturing technology, the organization should answer a few strategic questions:

-
- What are the business objectives and measurable goals for the new technology?
 - What strategic advantages do you need to stay competitive?
 - Does the smart manufacturing technology address a specific problem related to these competitive advantages?
 - What is the potential ROI for implementing this new technology?
 - How is the new technology compatible with legacy IT systems?
 - Does your current IT technology infrastructure have the bandwidth and capacity to handle increased volume of data input required to make Industry 4.0 technology successful?
 - Do you have controls in place to ensure the quality of data inputs?
 - Do you have team members with the required skills to implement successfully or do you need to bring in outside talent?
 - Do you have an executive sponsor who can help navigate unforeseen problems that will inevitably arise?
-

The best way to get started implementing a new solution is to start small. Think of one process you could improve or automate with a small budget that would make a large impact on the business.

Here are the top smart manufacturing technologies organizations are implementing today.

Cloud

Undoubtedly, the cloud has transformed manufacturing. On average, 66% of manufacturing enterprises from 17 countries reported using a cloud implementation and cloud-hosted services are expected to account for nearly half of all organization-level software usage among manufacturers by 2023.¹⁵

Industry 4.0 is being led by innovations in the cloud. Cloud computing technology solutions enable:

- **Cost Savings**
- **Security**
- **Flexibility**
- **Mobility**
- **Insight**
- **Increased Collaboration**
- **Quality Control**
- **Disaster Recovery**
- **Loss Prevention**
- **Automatic Software Updates**
- **Competitive Edge**
- **Sustainability**

Manufacturers implement cloud computing in one of three major ways: software as a service (SAAS), platform as a service (PAAS), or infrastructure as a service (IAAS).

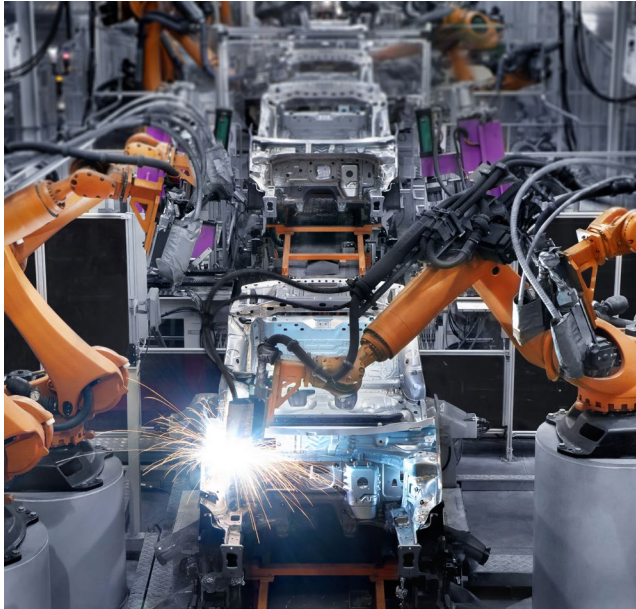
Cloud-computing is impacting nearly every aspect of modern manufacturing companies. At the corporate or enterprise level, cloud computing impacts how companies manage their operations – including from enterprise resource planning (ERP) and financial management to data analytics and workplace training. Cloud computing is transforming everything from how products themselves are researched, designed, and developed, to how they are manufactured, and used by customers. Additionally, cloud computing is playing a critical role toward enabling and democratizing new manufacturing production systems such as 3D printing (i.e., additive manufacturing) and the Industrial Internet of Things.¹⁶

Do you think on-premise technology solutions will exist in the future?

PROPEL PREDICTION

Cloud adoption will only increase across the entire manufacturing value chain. From video inspection on the factory floor to continued use of video collaboration tools for the remote workforce and value chain, real-time data collection will be at an all-time high. To compute and organize this data into actionable insights will take advances in 5G technology – which we're already seeing. New sales of on-premise solutions will cease by the end of this decade as cloud computing continues to take over the world.

Automation



Most processes can be automated – at least to an extent. When most people think of automation, they immediately think of robots and machines. While this is true, it's not the only thing being automated in the manufacturing process. Many remedial tasks, often performed by employees, are being outsourced to digital workers around the world. A digital worker is a human who is employed by an outside firm to accomplish low-skilled tasks.

But, totally automated factories are still far off for smaller manufacturers. Small manufacturing shops look to improve a few key production processes with strategic acquisition of robotics, software, and outsourced work. While large manufacturing organizations are running more by robots and automated processes.

Types of Industrial Robotics:

- **Articulated Robots** – A robot with rotary joints, usually powered by electric motors
- **Cartesian Robots** – Also called a linear robot, three principal axes of control are

linear and are at right angles to each other.

- **Cylindrical Robots** – Often powered by a pneumatic cylinder, the arm of this robot only goes up and down
- **SCARA Robots** – Popular option for small robotic assembly applications, the acronym stands for Selective Compliance Articulated Robot Arm, meaning it is compliant in the X-Y axis, and rigid in the Z-axis
- **Parallel Robots** – Also known as a parallel manipulator or parallel kinematic machines, they have higher precision and dynamic performance, which means they're often used for precise engineering
- **Collaborative Industry Robots** – Referred to as Cobots, they are designed specifically to work alongside humans

For example, Computerized Numerical Control or CNC machines used to rely on highly-skilled labor to create subtractive manufactured products. Recently, CNCs can now make parts without having an operator present or only with minimal human interaction. This has introduced the ability for “lights out manufacturing” or the ability to operate 24 hours a day with minimal employees for the second and third shifts.

One of the biggest automation changes in factories is 3D printing. This technology has been around since the 1980s but machines were previously too large and the process was too slow for mass adoption. Now, these machines are not only being used for prototyping, but also to complete finished products.

Today, manufacturing jobs make up 11% of jobs in the United States and 74% of all manufacturing is still performed

by humans. While this will reduce with automation, it will not drastically decrease to zero.¹⁷ There will be a number of displaced workers who will need to be reskilled. To retrain workers for the smart factory floor, employers must develop programs alongside training institutions to ensure the success of employees.

What percentage of tasks are you already automating?

PROPEL PREDICTION

We've lost more U.S. manufacturing jobs than we've gained over the last four years. Onshore jobs will not be wiped out by automation – but will require an upskilling of the existing workforce to operate smart machines at scale. Automation will increase the number of onshore jobs because machines are a fixed cost, which means more investment can be made into people across the smart manufacturing floor.

Artificial intelligence

Artificial intelligence is no longer science fiction – manufacturers are using it everyday – some without even knowing it. The smart manufacturing revolution is here to stay – and artificial intelligence is already powering the products we use in our daily lives.

Manufacturers are already using computer vision software that integrates existing image capturing devices to monitor safety and compliance. They use artificial intelligence to optimize inventory levels,

predict maintenance needs, and in combination with 3D printing for generative design.

Artificial intelligence can be broken down into several subcategories including machine learning and deep learning.

Machine learning is the use and development of computer systems that have the ability to learn and adapt by using algorithms and statistical models to analyze and draw inferences from patterns in data, without following explicit instructions. Supervised machine learning is the most commonly used machine learning technique since it leads to a predefined target – meaning the company has the input data, the company has the output data, and they're simply looking to map the function that connects the two variables.

Supervised machine learning does demand a high level of human involvement – data input, data training, choosing and defining algorithms, data visualizations, and more. The goal of supervised machine learning is to construct a mapping function with a level of accuracy that allows the system to predict outputs when new input data is entered into the system.

There are two main types of supervised machine learning: regression and classification.

Regression, in manufacturing, is often used to calculate an estimate for the Remaining Useful Life (RUL) of a resource or asset. The goal would be to create a prediction of how many days or cycles the resource has before the next failure.

Classification is used when data exists in well-defined categories. Sorting parts via a machine is an example of classification.

Unsupervised machine learning

is suitable for use cases where the outcome is unknown. Cluster analysis, or clustering, involves automatically discovering natural grouping in data that is unlabelled. It can reduce noise in big data sets.

Artificial Neural Networks are another example of unsupervised machine learning and are used in production process simulation and predictive quality analytics and predictive maintenance.

Deep learning is a machine learning technique that enables automatic learning through the consumption of data such as images, video, or text. Deep learning is being used for quality control and spotting other anomalies along the value chain.

With the rise of the Internet of Things, there is an increasing requirement of analyzing big manufacturing data defined by high volume, high velocity, and high variety.

Are you already analyzing data throughout your value chain using AI?

PROPEL PREDICTION

We'll see an increase in optimizing costs with real-time monitoring using data pulled from the manufacturing floor using 5G technology. AI will eliminate quality and operator failures throughout the supply chain because of a shorter loop of problem identification to solution implementation.

Industrial Internet of Things



Mckinsey reports that today's average factory is over 25 years old with machinery that is, on average, over nine years old. Industrial Internet of Things, or IIoT, is not all about replacing machinery, it's about optimizing existing machines to get even more lifespan out of them with predictive maintenance. IIoT applications for monitoring machine utilization can increase manufacturing productivity by 10 to 25% and produce up to \$1.8 trillion in global economic value by 2025.

Global spending on manufacturing IIoT platforms is predicted to grow from \$1.67B in 2018 to \$12.44B in 2024, attaining a 40% compound annual growth rate (CAGR) in seven years.¹⁹

It's clear that implementing IIoT technology is imperative to future factory success. But, it's no cakewalk. Inmarsat found that 72% of businesses have a shortage of people at the management level with experience in IIoT.²⁰ The manufacturing workers displaced by AI will see new jobs become

available – if they are flexible and can learn new skill sets as these new roles become available.

In order to successfully implement an IIoT project, or any smart manufacturing project, look at the questions in the beginning of this section and the overall strategy at the end.

There are two main use cases for IIoT:

- Predictive maintenance on existing systems and machines
- Part or product tracking

Predictive maintenance is a technique that uses data analysis to detect anomalies in your operations and possible defects in equipment and processes so you can fix them before they result in factory floor failure. Here are several [examples of predictive maintenance](#) in IIoT. Most often, existing machinery and systems are outfitted with IoT sensors rather than brand new machines with this innovative technology built-in.

Product or piece tracking is another use case for IOT. For example, Airbus implemented an IOT and smart-glasses solution that helps team members identify the correct parts. Sensors may also track large shipments as they make their way around the globe.

While many factories are implementing IIoT, we know that many are not successful. Cloud-computing and IIoT are the two Industry 4.0 technologies that are nearly impossible to avoid. Either you or your partners will be using them – and you need to build a strategy that enables cross-collaboration.

Did you know that predictive maintenance can reduce companies' maintenance costs by 20%, reduce unplanned outages by 50% and extend machinery life by years? ²¹

PROPEL PREDICTION

IIOT is simply real time data provided by multiple sources. Companies that integrate that data with their people and processes will reduce maintenance costs. But the most successful companies will create entirely new business models by leveraging the data to sell outcomes rather than products.

Skill Gaps and Paybacks

It's clear that smart manufacturing is the future. It's already helping manufacturers produce more while reducing costs.

The global smart factory market was valued at \$252.29 billion USD in 2019 and is expected to reach \$422.88 billion by 2025. A survey by Microsoft found that 85% of companies surveyed have at least one IIoT use case project and 94% of the respondents said they will implement IIoT strategies by 2021. ²²

But... There are two major questions threatening the future of smart manufacturing.

- What about the employees?
- What's the payback period?

When new technology takes over the entire value chain, from new Product Lifecycle Management software to robots and digital workers, employees can become

disengaged. It's not that employees don't want to work – it's often they find decisions being made without their input. They're then expected to rapidly learn new systems put in place by upper management.

According to Inbound Logistics, one in every six U.S. jobs is now tied to manufacturing, thanks to the digital age of 3D printing, big data, and robotics.²⁵

As it's done historically, technology will create more jobs than it destroys.

The issue?

Employee skills matching job demands.

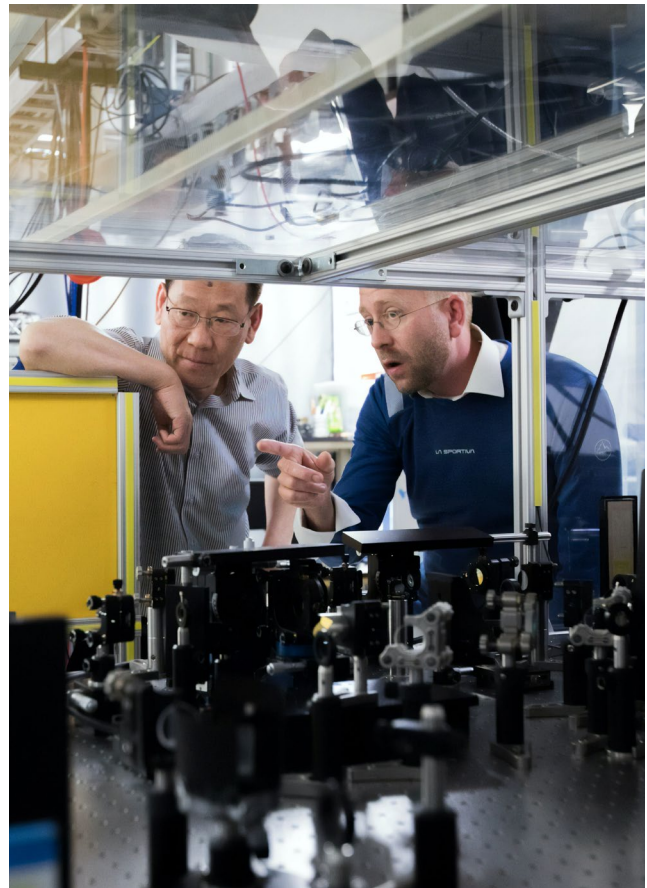
As technology replaces many of the manual and repetitive tasks performed by humans, needed skills start to shift from process-oriented to human-oriented.

Communication, collaboration, and critical thinking become more important than ever before, throughout the entire manufacturing process from the factory floor to the executive offices.

But, hard skills are still critical as well. Learning these hard skills used to come from apprenticeships, internships, and earning certificates from outside providers. Today, however, companies are having to invest in their employees skills firsthand through building their own employee training programs.

Employees are no longer disposable – their deep expertise in Industry 4.0 technology empowers them to be knowledge workers. This shift is disrupting manufacturing as we know it.

While manufacturing companies are relying more on technology than humans, humans have never been more important.



If they can't learn these new systems and technologies? They're likely fired rather than reskilled. While manufacturing companies are relying more on technology than humans, humans have never been more important. In the future, no longer will humans be doing routine tasks – they'll be servicing complex machinery and software.

According to a survey conducted by The Manufacturing Institute and Deloitte Consulting LLP, approximately 22% of skilled manufacturing workers (almost 2.7 million employees) will be retiring within the next 10 years. In addition, another 700,000 workers will be needed due to industry growth.²³

This reskilling revolution must be prioritized for companies of all shapes and sizes. Salesforce can be seen as a tremendous example in reskilling workers with their emphasis on [empowering former military to be Salesforce administrators](#).

Manufacturing companies should look to do the same.

Now... about the payback period of implementing Industry 4.0 technologies.

Cisco reported that 76 percent of IoT projects fail and a third of all completed IOT projects were considered failures. This is across all industries, but manufacturing is at the forefront of IOT innovation – meaning they’re succumbing to these failures.

Only 5 percent of US manufacturers surveyed reported full conversion of at least one factory to “smart” status, with another 30 percent reporting they are currently implementing initiatives related to smart factories.²⁴

McKinsey’s work has found that European manufacturing is lagging behind the rest of the world. Only 17 of the 44 members of the Global Lighthouse Network (manufacturers that have been recognized as leading in their adoption of digital technologies) are in Europe, and only 3 of these are using smart manufacturing tools across their end-to-end value chains.²⁵

Nearly two out of three manufacturers surveyed report no progress on smart manufacturing initiatives that they overwhelmingly point to as their main driver of near-term competitiveness in five years.

This is both good news and bad news.

On the good side, it means that there is a significant opportunity to adopt smart manufacturing technologies to beat your competitors. On the other hand, implementing these technologies requires immense effort, focus, and planning.

We recommend this six phase approach to implementing smart manufacturing technology:

- 1 **Diagnose the problem you’re trying to solve.** This might be increasing the output of a certain step in your manufacturing process or needing to keep everyone at the company on the same page throughout the product development process.
- 2 **Map out the current process.** You may need to do a thorough value chain analysis in order to accurately analyze each step in the process. Always be thinking about how this process impacts the customer.
- 3 **Investigate new technologies.** Do thorough research of the possible solutions on the market which could involve improving people, processes, or technology. You should have a buying committee with members from across the organization so they can understand unique perspectives of the suggested technology.
- 4 **Create goals.** Once you understand the available solutions, you should be able to set realistic goals based on the company’s previous experiences implementing these types of solutions. For example, a company should be able to say that 80% of customers implement a new technology in _ days with _ success rate.
- 5 **Bring the team along.** Ask team members their thoughts and opinions on different technologies. Getting early buy in means there will be a higher adoption rate later on.
- 6 **Start with a test.** While overhauling your complete value chain might be the dream, take it one step at a time. Think how this technology can be tested against solving your problem over a month and make iterative changes

Manufacturers who don't keep up with the latest technology will find themselves falling behind the times – which will lead to integration conflicts and cybersecurity issues when working with suppliers and value chain partners that have embraced the technology. At some point, these issues will either force the lagging manufacturers to upgrade their technology all at once – which could be a painful experience – or see them lose business altogether as partners decide the difficulty and risk of working with technology laggards are not worth the effort and expense.

We aren't predicting a smart manufacturing future, we're predicting a smart manufacturing failure if companies don't take reskilling workers and implementing strategic plans seriously.

PROPEL PREDICTION

Manufacturers will pay for their workforce to level up because the costs are too great not to. When implementing IIOT, organizations should start small with a land and expand strategy to drive a positive return on investment. Rather than overhauling complete systems, manufacturers should look at incremental process improvements that integrate with their existing technologies.



Remote Work

Before the pandemic, roughly 3.4% of the US population worked solely from home. Once the pandemic hit, 88% of business organizations, worldwide, made it mandatory or encouraged their employees to work from home.²⁶



Manufacturing is all about the physical world – it’s fundamentally about turning raw materials into finished products.

This typically requires many humans to be in a confined factory floor space, working in tight quarters. And while some manufacturing processes are automated, many are not.

Typically, non-production staff is anywhere between 25% and 50% of total headcount. This means there is an opportunity for a significant portion of employees to work remotely, but only if they’re empowered with the right technology, processes, and communication.²⁷

Surveyed workers have, time and time again, shown to be more productive when working from home. Remote work is also cited as one of the top non-monetary ways to increase employee morale. If someone can work remotely, especially during these times, they should be.²⁸

Remote work tossed a wrench into many systems and processes, especially for manufacturing, an industry where not all jobs can be performed externally. This division between work from home employees and those essential workers who had to keep the factory running was highlighted by failed systems and processes – mostly due to on premise technology that couldn’t be accessed by remote workers.

Connecting factory-floor, in-person employees to their remote teammates requires the right technology. This is why we’re seeing a rise in the adoption of cloud PLM, ERP, CRM, CMS, and QMS over on-premise solutions.

How will you ensure remote workers are connected to the factory floor?

PROPEL PREDICTION

Remote work is here to stay – but with a blended amount of in-office (or factory) time. Simplified communication between all parties in the manufacturing process will only become more imperative as the workforce and supply chains become more distributed. We’ll see a rise in the adoption of cloud communication technologies built upon existing solutions, like Salesforce, that enable company-wide collaboration around the globe.

The New Workforce



While the fourth industrial revolution may be about the rise of computing and automation, manufacturers can not forget about the most important piece of the puzzle: people.

People are behind the machines and engineering that will propel us into the future. Their ability to work efficiently and effectively is key.

It's no surprise that the workforce is changing; it is surprising how many employers are behind the times in understanding how this new generation of workers will operate and their overall needs.

The workforce has never been as nuanced and assorted as it is today. With full-time and part-time employees, freelance, and gig workers, in addition to the aforementioned remote option, the workplace is completely shifting.

Surveys reveal 82% of company leaders plan to allow employees to work remotely for at least part of the time.²⁹

Deloitte's 2018 Global Human Capital Trends report found that less than 43 percent of respondents' organizations are primarily made up of salaried employees.³⁰

These two statistics highlight the tip of the iceberg when it comes to the new workforce.

The changing workforce has many advantages, for employees and employers alike, but it also brings challenges.

For employers, the advantages are an on-demand workforce, available at all times. Whatever job you need to fill, there are agencies, organizations, and individuals ready to work. You can also have an "always-on" workforce where your customer success team is distributed globally to ensure complete coverage.

But, this workforce has high demands from their employers. Upcoming generations are technologically driven and dependent. They require technology and infrastructure that is simple to use with a convenient user experience. While dependent on technology, it should holistically make employees more engaged and more productive. No longer is easy-to-use software a nice to have, it's a must.

As organizations rely more on human capital as part of business valuations, the need for a well-educated, excited, and engaged workforce has never been higher.

And it's not just about the employees sitting at the top in the office. Manufacturers must focus on their entire workforce from the highest level executive to the individual crafting the product. Companies focused on differentiation will invest in the education of their global workforce, while those focused on cost reduction may cut corners and rely on less-skilled workers.

Technology will empower all of these new positions - which is why when we look at hiring future generations, the technology they use on-the-job must be as easy to use as the tech they're used to in their personal lives.

Some new titles of this changing workforce include:

- **Digital twin engineer**
- **Predictive supply chain analyst**
- **Robot teaming coordinator**
- **Smart factory manager**
- **Robotic technician**
- **Mechatronics engineer**

These are highly skilled jobs that require intensive training. They don't seem like your typical manufacturing jobs – but they will be in the future.

These jobs, especially within companies who nearshore or onshore, will be highly lucrative. It's likely that we will see freelance consultants across the manufacturing industry. They will offer highly specialized skills on a project basis for a wide range of manufacturers.

What percentage of your workforce is Millennials and Generation Z?

PROPEL PREDICTION

Manufacturers will have to focus more on supplementary benefits beyond salary to attract the best Gen Z talent. We'll also see a rise in on-demand workers who are not employed by one single employer but work across multiple manufacturers. These workers will likely be highly skilled and can implement IIOT, automation, and cloud technologies. We'll see wild new titles appear across the manufacturing value chain. Specific roles that aren't technical, like customer success and marketing, will see an increase in value as competition increases and these become differentiating factors.



Propelling the Future of Innovation in Manufacturing

The future isn't far off – it's happening right in front of us. This push towards innovation and adaptability has forced companies to think about the future. While most digital transformation initiatives fail, we're seeing companies put more effort into transforming their organizations than ever before – because they have to.

The macro trends mentioned throughout this piece will shape the future for all manufacturers. How manufacturers handle tomorrow depends on what they do today. Building resilient value chains is not an overnight task.

In order to not only survive but to thrive in the next normal, companies must stay ahead of the curve of the unknowns ahead.

To do this, companies must understand global trade initiatives, adopt innovative cloud-based technologies, and focus on diversity through their value chain.

Putting the customer at the forefront of every decision while navigating these larger macro trends will ensure you're always on the right path.





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